

# Technology Paper

## 10 Questions you need to ask before you purchase a new solid-state transmitter

### 1

#### How is energy efficiency measured?

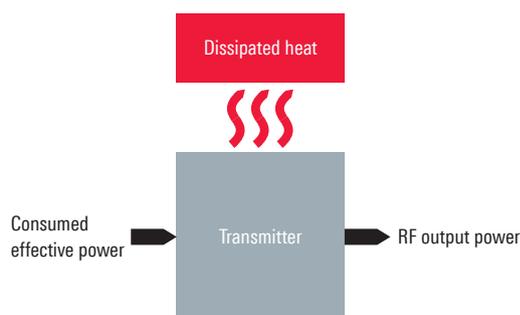
Every transmitter manufacturer has a method for calculating energy efficiency. As a result, it can be difficult to get a true apples-to-apples comparison. At Rohde&Schwarz, our efficiency formula is straightforward: average RF output power divided by AC active power consumption, including the power required to operate all ancillary equipment (i.e., heat pumps, heat exchangers, and harmonic filters). Our efficiency ratings take into account the total transmission package. In contrast, some companies calculate efficiency by comparing DC-to-RF efficiency at the circuit level, which negates a lot of components required for broadcast. Whatever transmitter you may consider, be sure you understand the formula.

### 2

#### How does efficiency change based on operating output?

Efficiency ratings are measured based on the maximum output power of the transmitter. Some transmitters set at lower power – for example, a 10 kW transmitter that is only tasked with 5 kW TPO – operate at less efficiency. Rohde&Schwarz has developed Adaptive Efficiency Optimization, which can increase efficiency by up to 3% for transmitters not operating at full power through automated DC voltage alignment. Whether you change RF channel, TPO, or modulation (i.e., ATSC 3.0), Rohde&Schwarz helps you achieve optimal efficiency and MER while maintaining superb signal quality.

#### Definition of efficiency



$$\text{Energy efficiency} = \frac{\text{average RF output power}}{\text{AC active power consumption}}$$

### 3

#### How can I calculate true cost of ownership?

Amplifier technology is crucial when determining cost of ownership, especially for stations with high-power transmitters. Most transmitters operate at reduced output power to have some “headroom” – and conventional transmitters experience a significant reduction in efficiency at reduced power. Rohde&Schwarz amplifiers allow optimizing efficiency even at reduced power levels, and our software-based Efficiency Optimization tool adjusts several parameters while monitoring signal quality at the transmitter output, so you can find the sweet spot of best efficiency vs. influencing quality. We also offer a large power range to make sure you get the right transmitter for your coverage area.



# 4

## Will the transmitter I buy today be compatible with ATSC 3.0 tomorrow?

Before the FCC repack is complete, broadcasters expect to begin the transition to ATSC 3.0, a new broadcast standard that will enable mobile applications, significantly higher data rates, targeted advertising, and other innovative services. The change to ATSC 3.0 is about more than just the exciter – mobile applications may require a change in the polarization of the transmit antenna, and some RF components have different ratings for 8VSB (ATSC) and OFDM (ATSC 3.0).

To provide broadcasters with an easy upgrade path for existing R&S®Tx9 high-power transmitters, Rohde&Schwarz developed the SDE900, the first IT server-based exciter solution for ATSC 3.0. The plug-in, rack-mount module features a software-based encoder that generates I/Q modulation data on its IT server. Then, the R&S®TCE900/TCE901 exciter generates the COFDM waveform based on the IQ data. The SDE900 provides flexibility for broadcasters to respond to the anticipated signal processing requirements of ATSC 3.0 and beyond.

# 5

## How can Doherty technology improve signal amplification and give you more for repack?

Based on a principle developed by William H. Doherty back in 1936, Doherty amplification separates the peak and average power signals by using two amplifiers. The main amplifier operates as a normal broadcast amplifier, but when it reaches the back-off point, a peak amplifier joins the main amplifier to amplify the peak signals. The main and peak amplifier outputs combine to produce the final output power. Compared to standard solid-state transmitters, high-power broadcast amplifiers with Doherty technology deliver up to 43% efficiency – and are on par with MS-DC-IOT transmitters. Since 2012, Rohde&Schwarz's two-way Doherty solution has delivered the highest efficiency of any Doherty implementation over the whole UHF frequency band. Plus, we use only one hardware platform for all frequency ranges, which simplifies spare part requirements.

Note: You might get a head start on some sites by installing the new transmitter on the "old" frequency before changing to the new frequency. Make sure your new transmitter supports all UHF frequencies up to 700 MHz (channel 51) with a single hardware broadband amplifier you can tune without soldering to any frequency.

# 6

## Can you trust solid-state technology to replace IOT technology in high-power transmitters?

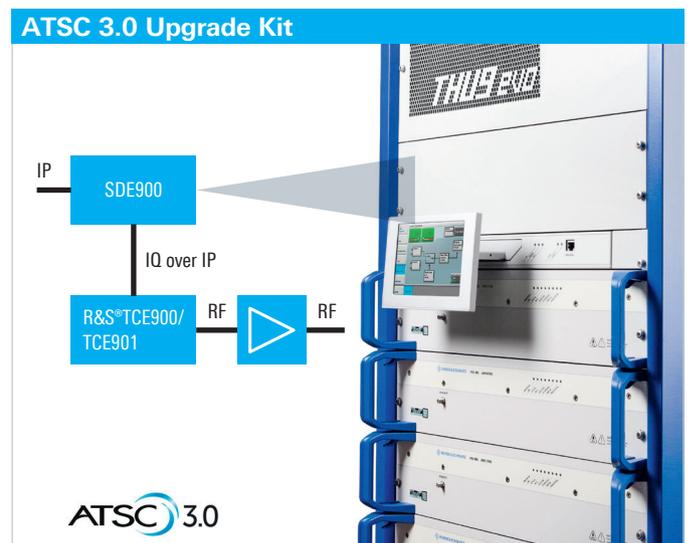
The FCC repack is no time to experiment with new transmitter technology. You want proven technology with a large installed base – and today, solid-state transmitters have become the dominant solution for high-power broadcast transmitters. If you haven't installed a transmitter since the DTV transition, you might be surprised at the advances in amplifier technology over the last decade.

With the successful implementation of the Doherty principle, solid-state transmitters now have the same or better efficiency than IOT models. Current 50V LDMOS transistors deliver dramatically higher output for solid-state transmitters in a very compact form factor. Plus, solid-state architecture is much more reliable and stable, with significantly less expensive annual maintenance costs. IOT technology is more hazardous because it requires more voltage – and when you lose a tube, you lose your signal, so failures are catastrophic. Rohde&Schwarz already has solid-state transmitters installed at television and FM radio stations throughout the United States, including the world's largest solid-state transmitter for WNJU in the World Trade Center.

# 7

## How should my station evaluate a reliable liquid-cooled transmitter?

Liquid-cooled, solid-state architecture offers a number of advantages. It allows for higher power density and more efficient operation that requires less maintenance. Plus, the transmitter itself is extremely quiet and generates a



minimal heat load into the room, which means you won't have to spend a fortune on air conditioning (or maintaining the AC unit). Air-cooled components (i.e., power supplies, combiner, etc.) in the transmitters consume more power than liquid-cooled transmitters with the same TPO, which translates to higher annual energy costs. Bonus: The liquid-cooled transmitters have better power efficiency.

Rohde&Schwarz has installed more than 10,000 liquid-cooled systems. Our R&S®THU9 liquid-cooled transmitters have a highly efficient design, with three power supplies for redundancy and no interconnecting hoses or cables. It's a closed cooling circuit – all critical components are protected from external influences like dust and humidity. That means no blocked air filters or icing. There are only two hose connections in the transmitter, but the system provides a complete cooling solution that removes the maximum amount of heat.

## 8

### Will the transmitter manufacturer be able to fulfill my order in time to meet my station's FCC repack deadline?

It's going to be an exceptionally busy few years for the broadcast industry. Throughout the FCC repack, all vendors will be flooded with transmitter orders and pushed to meet delivery times. Remember, the FCC repack isn't happening in a bubble; beyond stations impacted by the repack, many other broadcasters will want to upgrade their transmitters due to the adoption of ATSC 3.0 or simply because it's time to replace aging equipment.



Rohde&Schwarz's factory has the capacity to sustain the elevated order load without cutting corners in testing or production quality. We have approximately 700,000 square feet of production space with more than 1,500 employees, and we manufacture 90% of components in house. This benefits your station with the low lead times, scheduling flexibility, and the highest quality standard. Plus, you'll have maximum parts availability even after product phase out.

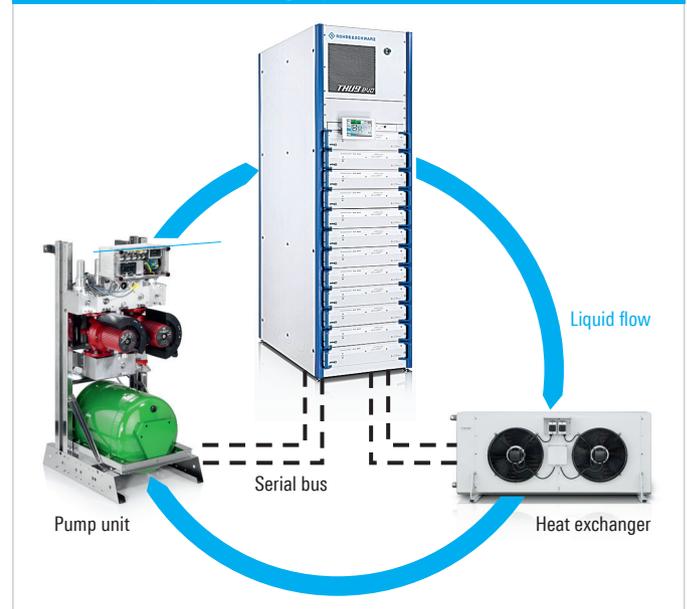
## 9

### Who will handle the installation?

The FCC repack is about more than upgrading your transmitter. Rohde&Schwarz offers a turnkey solution for stations who are facing the daunting repack deadlines with limited personnel and resources. We partner with Dermac Group and dozens of trained and certified contractors to support our installation services. R&S Project Management provides comprehensive, end-to-end project management and full documentation for FCC requirements.

We do it all – after a detailed site survey, the knowledgeable Rohde&Schwarz team provides a scope of work (SOW) that accounts for contingencies to eliminate customer risk. Rohde&Schwarz can install equipment, decommission old equipment and dispose of hazardous materials, and even coordinate efforts with other contractors, when necessary. Rohde&Schwarz will keep your transition on track, maximize your budget, and help you get faster FCC reimbursement.

### Efficient liquid cooling system



# 10

## What support level can I expect from the manufacturer?

A new transmitter is a long-term investment in technology that will be in service for at least a decade – and will be directly responsible for creating your company's revenue. Over that time, you'll need training, spare parts, and services, so you need to consider the reliability and stability of your equipment supplier.

Rohde&Schwarz has been a privately owned company group for more than 80 years, and more than 10,000 employees worldwide. Our first FM transmitter, the first FM transmitter in Germany, went on the air in 1949. We are among the technology and market leaders in a number of business fields, and with more than 3,000 highly trained manufacturing experts, we have complete control over product quality and capacity. Rohde&Schwarz has built our reputation on exacting standards and excellent customer service, and with more than 500 employees on our North American team, we'll be here to provide all the support you need for as long as you'll need it.

### Full range of Doherty transmitters



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